Developing Resources for Advanced Breeding Technologies
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Research Summary:
Wheat is one of the most important cereal crops in the state of South Dakota. Maintaining and increasing winter yields and profitability are the primary goals of the SDSU wheat breeding programs. Establishing a plant breeding database is critical for an efficient of the breeding program in the present era when a huge amount of genotype and phenotype data are being generated for advanced breeding methodologies like genomic selection and trait assured breeding. Development of a modern and competitive wheat breeding program will in turn help producers and the economy of South Dakota.

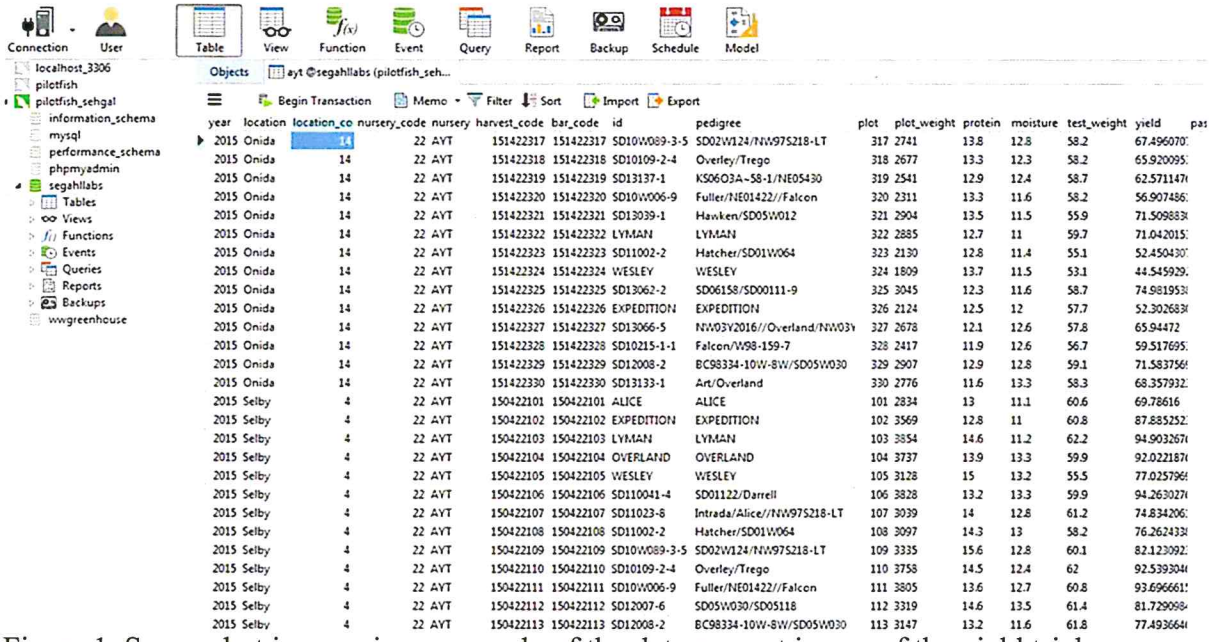
Introduction:
Nearly 700-800 unique crosses are made every year in winter wheat breeding program and more than 15-20,000 head rows and 6-8,000 plots are evaluated every year in the winter wheat breeding program at SDSU. Observations are recorded on more than 15 traits every year generating a huge amount of valuable data. However, in the absence of relational databases, the data from each of these years are not associated, which limits its utility. Developing Relational Database Management System for plant breeding will lead to better management of pedigrees, nurseries, characterization, and evaluation trials, trait evaluation, germplasm management and genotype information. Further, integration of the database with breeding software will lead to better design and analysis on a routine basis.

The objective of the project was to establish a plant breeding database for SDSU wheat breeding program for efficient data management and analysis.

Description of Accomplishments:

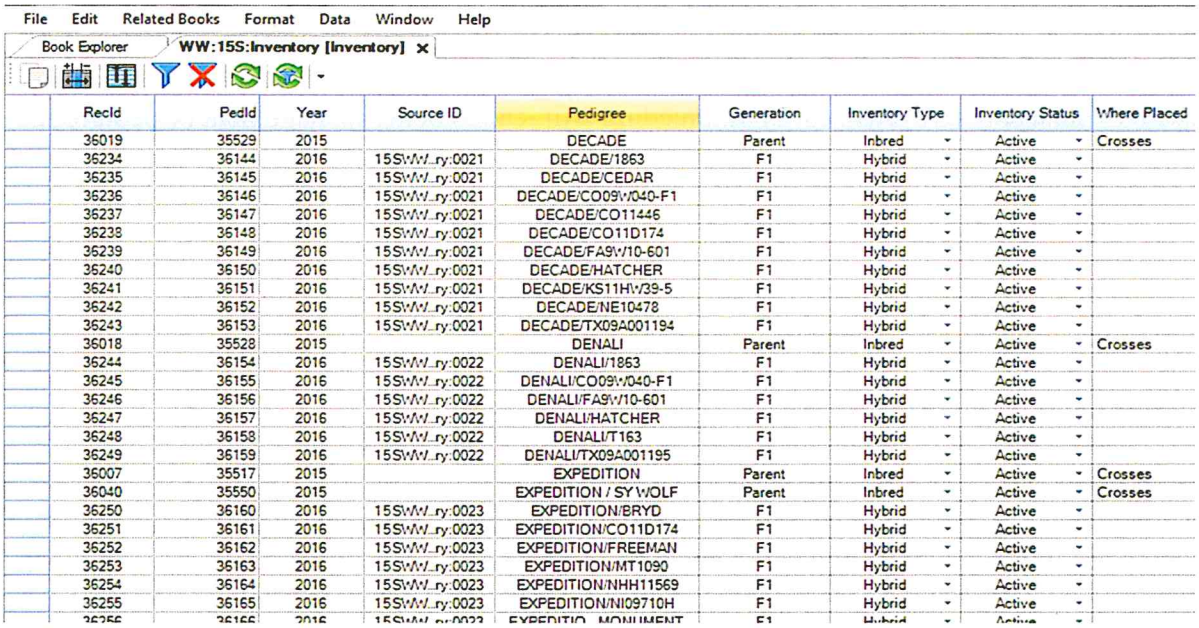
Setting up of server and establishment of databases.
We bought UCS B-series computer server with 48 cores and a memory (RAM) of 384 Gb. The machine has internal storage of 450 Gb and SAN storage of 2 Tb. A Windows and Linux server (Ubuntu 14.1) were setup on the machine. A MySQL relational database was setup on the server, which can be accessed using Navicat software. The database is housing all available inventory information of winter wheat breeding program from 2004 onwards (Figure 1).

The database is linked to pedigree management and analysis tool PRISM that will be used to perform analytical and statistical operations on plant breeding based data. PRISM houses data as field books (Figure 2).



year	location	location_co	nursery_code	nursery	harvest_code	bar_code	id	pedigree	plot	plot_weight	protein	moisture	test_weight	yield	pas
2015	Onida	14	22	AYT	151422317	151422317	SD10W089-3-5	SD02W124/NW97S218-LT	317	2741	13.8	12.8	58.2	67.496070	
2015	Onida	14	22	AYT	151422318	151422318	SD10109-2-4	Overley/Trego	318	2677	13.3	12.3	58.2	65.920095	
2015	Onida	14	22	AYT	151422319	151422319	SD13137-1	KS06O3A-58-1/NE05430	319	2541	12.9	12.4	58.7	62.571147	
2015	Onida	14	22	AYT	151422320	151422320	SD10W006-9	Fuller/NE01422//Falcon	320	2311	13.3	11.6	58.2	56.907486	
2015	Onida	14	22	AYT	151422321	151422321	SD13039-1	Hawken/SD05W012	321	2904	13.5	11.5	55.9	71.509883	
2015	Onida	14	22	AYT	151422322	151422322	LYMAN	LYMAN	322	2885	12.7	11	59.7	71.042015	
2015	Onida	14	22	AYT	151422323	151422323	SD11002-2	Hatcher/SD01W064	323	2130	12.8	11.4	55.1	52.450430	
2015	Onida	14	22	AYT	151422324	151422324	WESLEY	WESLEY	324	1809	13.7	11.5	53.1	44.545929	
2015	Onida	14	22	AYT	151422325	151422325	SD13062-2	SD06158/SD00111-9	325	3045	12.3	11.6	58.7	74.981953	
2015	Onida	14	22	AYT	151422326	151422326	EXPEDITION	EXPEDITION	326	2124	12.5	12	57.7	52.302683	
2015	Onida	14	22	AYT	151422327	151422327	SD13066-5	NW03Y2016//Overland/NW03Y	327	2678	12.1	12.6	57.8	65.94472	
2015	Onida	14	22	AYT	151422328	151422328	SD10215-1-1	Falcon/W98-159-7	328	2417	11.9	12.6	56.7	59.517695	
2015	Onida	14	22	AYT	151422329	151422329	SD12008-2	BC98334-10W-8W/SD05W030	329	2907	12.9	12.8	59.1	71.583756	
2015	Onida	14	22	AYT	151422330	151422330	SD13133-1	Art/Overland	330	2776	11.6	13.3	58.3	68.357932	
2015	Selby	4	22	AYT	150422101	150422101	ALICE	ALICE	101	2834	13	11.1	60.6	69.78616	
2015	Selby	4	22	AYT	150422102	150422102	EXPEDITION	EXPEDITION	102	3569	12.8	11	60.8	87.885252	
2015	Selby	4	22	AYT	150422103	150422103	LYMAN	LYMAN	103	3854	14.6	11.2	62.2	94.903267	
2015	Selby	4	22	AYT	150422104	150422104	OVERLAND	OVERLAND	104	3737	13.9	13.3	59.9	92.022187	
2015	Selby	4	22	AYT	150422105	150422105	WESLEY	WESLEY	105	3128	15	13.2	55.5	77.025796	
2015	Selby	4	22	AYT	150422106	150422106	SD110041-4	SD01122/Darrell	106	3828	13.2	13.3	59.9	94.263027	
2015	Selby	4	22	AYT	150422107	150422107	SD11023-8	Intrada/Alice//NW97S218-LT	107	3039	14	12.8	61.2	74.834206	
2015	Selby	4	22	AYT	150422108	150422108	SD11002-2	Hatcher/SD01W064	108	3097	14.3	13	58.2	76.262433	
2015	Selby	4	22	AYT	150422109	150422109	SD10W089-3-5	SD02W124/NW97S218-LT	109	3335	15.6	12.8	60.1	82.123092	
2015	Selby	4	22	AYT	150422110	150422110	SD10109-2-4	Overley/Trego	110	3758	14.5	12.4	62	92.539304	
2015	Selby	4	22	AYT	150422111	150422111	SD10W006-9	Fuller/NE01422//Falcon	111	3805	13.6	12.7	60.8	93.696661	
2015	Selby	4	22	AYT	150422112	150422112	SD12007-6	SD05W030/SD05118	112	3319	14.6	13.5	61.4	81.729098	
2015	Selby	4	22	AYT	150422113	150422113	SD12008-2	BC98334-10W-8W/SD05W030	113	3147	13.2	11.6	61.8	77.493664	

Figure 1. Screenshot image gives a sample of the data present in one of the yield trial.



RecId	PedId	Year	Source ID	Pedigree	Generation	Inventory Type	Inventory Status	Where Placed
36019	35529	2015		DECADE	Parent	Inbred	Active	Crosses
36234	36144	2016	15SWW_ry:0021	DECADE/1863	F1	Hybrid	Active	
36235	36145	2016	15SWW_ry:0021	DECADE/CEDAR	F1	Hybrid	Active	
36236	36146	2016	15SWW_ry:0021	DECADE/CO09W040-F1	F1	Hybrid	Active	
36237	36147	2016	15SWW_ry:0021	DECADE/CO11446	F1	Hybrid	Active	
36238	36148	2016	15SWW_ry:0021	DECADE/CO11D174	F1	Hybrid	Active	
36239	36149	2016	15SWW_ry:0021	DECADE/FA9W10-601	F1	Hybrid	Active	
36240	36150	2016	15SWW_ry:0021	DECADE/HATCHER	F1	Hybrid	Active	
36241	36151	2016	15SWW_ry:0021	DECADE/KS11HW39-5	F1	Hybrid	Active	
36242	36152	2016	15SWW_ry:0021	DECADE/NE10478	F1	Hybrid	Active	
36243	36153	2016	15SWW_ry:0021	DECADE/TX09A001194	F1	Hybrid	Active	
36018	35528	2015		DENALI	Parent	Inbred	Active	Crosses
36244	36154	2016	15SWW_ry:0022	DENALI/1863	F1	Hybrid	Active	
36245	36155	2016	15SWW_ry:0022	DENALI/CO09W040-F1	F1	Hybrid	Active	
36246	36156	2016	15SWW_ry:0022	DENALI/FA9W10-601	F1	Hybrid	Active	
36247	36157	2016	15SWW_ry:0022	DENALI/HATCHER	F1	Hybrid	Active	
36248	36158	2016	15SWW_ry:0022	DENALI/T163	F1	Hybrid	Active	
36249	36159	2016	15SWW_ry:0022	DENALI/TX09A001195	F1	Hybrid	Active	
36007	35517	2015		EXPEDITION	Parent	Inbred	Active	Crosses
36040	35550	2015		EXPEDITION / SYWOLF	Parent	Inbred	Active	Crosses
36250	36160	2016	15SWW_ry:0023	EXPEDITION/BRYD	F1	Hybrid	Active	
36251	36161	2016	15SWW_ry:0023	EXPEDITION/CO11D174	F1	Hybrid	Active	
36252	36162	2016	15SWW_ry:0023	EXPEDITION/FREEMAN	F1	Hybrid	Active	
36253	36163	2016	15SWW_ry:0023	EXPEDITION/MT1090	F1	Hybrid	Active	
36254	36164	2016	15SWW_ry:0023	EXPEDITION/NHH11569	F1	Hybrid	Active	
36255	36165	2016	15SWW_ry:0023	EXPEDITION/NI09710H	F1	Hybrid	Active	

Figure 2. Snapshot of the field book present in the MSSQL database in PRISM.

Projections:

The server and the databases are established and breeding data of last 8 years is up loaded into the databases. The database will be further refined as it grows in volume with different phenotype and genotype data that will be collected over the years. The data generated in the breeding program will be regularly updated into the databases for storage and analysis. This will improve efficiency of phenotype and genotype data collection, organization, analysis and utilization in breeding programs.